11/066,108

A

EXPRESS MAIL NO.
EL650658128US

Docket No. 80A 3002
Date: November 3, 2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Transmitted herewith for filing is the patent application for inventor(s):

MITSURU TAKEYASU, TADAHIRO ARIMURA, YOSHIHISA TABATA and DAISUKE KAIBARA

For: AN LED LIGHTING FIXTURE

Also enclosed are:

☒ 6 sheets of drawings

☐ Certified copy of Japanese Patent Application No. 11-315519 of November 5, 1999 on which Convention priority is claimed (to follow)

☒ Declaration and Power of Attorney

☒ Verified Statement Claiming Small Entity Status

☐ Information Disclosure Statement by Applicant

☐ Preliminary Amendment

☒ An assignment of the invention to ZENI LITE BUOY CO., LTD.

CALCULATION OF FEES								
ITEM		TOTAL NO. OF CLAIMS		NO. OF CLAIMS OVER BASE	LG/SM $ ENTITY FEE		$ AMOUNT	$ FEE
A	TOTAL CLAIMS FEE	7	-20	0	LG=$18 SM=$9	$9	$ 0	
B	INDEPENDENT CLAIMS FEE*	3	-3	0	LG=$80 SM=$40	$40	$ 0	
C	SUBTOTAL - ADDITIONAL CLAIMS FEE (ADD FINAL COLUMN IN LINES A + B)							$ 0
D	MULTIPLE-DEPENDENT CLAIMS FEE				LARGE ENTITY FEE = $270 SMALL ENTITY FEE = $135			$ 0
E	BASIC FEE				LARGE ENTITY FEE = $710 SMALL ENTITY FEE = $355			$ 355
F	TOTAL FILING FEE (ADD TOTALS FOR LINES C, D, AND E)							$ 355
G	ASSIGNMENT RECORDING FEE						$ 40	$ 40
	*LIST INDEPENDENT CLAIMS 1, 4, 7							

☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Account No. 11-1445. A duplicate copy of this sheet is enclosed.

☒ A check in the amount of $ 355 to cover the filing fee is enclosed.

☒ A check in the amount of $ 40 to cover Assignment Recordation fee is enclosed.

Respectfully submitted,
KODA & ANDROLIA

By: _____
H. Henry Koda
Reg. No. 27,729

2029 Century Park East
Suite 3850
Los Angeles, CA 90067-3024
(310) 277-1391
(310) 277-4118 -fax

KODA & ANDROLIA
USA
SMALL BUSINESS

Applicant or Patentee: Mitsuru Takeyasu, et al. Attorney's
Serial or Patent No.: Docket No.: 80A 3002
Filed or Issued:
For: An LED Lighting Fixture

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9 (f) and 1.27 (c)) — SMALL BUSINESS CONCERN

I hereby declare that I am

[ ] the owner of the small business concern identified below:

[X] an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN ZENI LITE BUOY CO., LTD.
ADDRESS OF CONCERN 176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9 (d), for purposes of paying reduced fees under section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled AN LED LIGHTING FIXTURE by inventor(s) MITSURU TAKEYASU, TADAHIRO ARIMURA, YOSHIHISA TABATA and DAISUKE KAIBARA described in

[X] the specification filed herewith
[ ] application serial no. , filed .
[ ] patent no. , issued .

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9 (d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9 (d) or a nonprofit organization under 37 CFR 1.9 (e).

*NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME
ADDRESS
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

NAME
ADDRESS
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28 (b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Tadashi TAKEYASU
TITLE OF PERSON OTHER THAN OWNER President
ADDRESS OF PERSON SIGNING 176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan

SIGNATURE T. Takeyasu DATE 17 July 2000

AN LED LIGHTING FIXTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lighting fixture used as a navigational aid, using light-emitting diodes (LEDs) having different divergence angles in the horizontal and perpendicular directions, i.e., a so-called elliptic light distribution, as the light source.

2. Prior Art

LEDs are widely used as light sources in navigational aids on account of their low power consumption and low failure rate.

Because the light-emitting energy of a single LED is small, a tubular lens is typically used to surround several LEDs in order to concentrate their light by convergence, thereby increasing their effective illumination. However, if LEDs with a high convergence rate are arranged in a large array, their light is not distributed uniformly in the horizontal circumferential direction, which is how the light should ideally be distributed. Therefore, in order to distribute the light horizontally and uniformly, LEDs with a wider divergence angle have been used conventionally.

Typically the divergence angle is 30° or so for both the horizontal divergence angle and the perpendicular divergence angle. To make the horizontal light distribution more nearly concentric, a multitude of LEDs need to be arranged horizontally. In some cases, as many as 80 LEDs are arranged in a row.

Since typical lighting fixtures for navigational aid purposes use several tiers of LEDs, the total number of LEDs used in a lighting fixture can be very large.

As the number of LEDs per tier increases, the outer diameter of the substrate on which the LEDs are mounted also needs to be increased, with the result that the outer diameter of the lighting fixture has to be made larger.

SUMMARY OF THE INVENTION

The object of the present invention is to provide an LED lighting fixture that makes the horizontal light distribution nearly concentric using as few LEDs as possible, thereby realizing uniform and horizontal light distribution.

Another object of the present invention is to provide an LED lighting fixture in which the size and weight of the lighting fixture is as small as possible by minimizing the number of LEDs required.

When arranging several tiers of LEDs and surrounding them with a tubular lens so that the light from the LEDs converges, different sizes of lenses are necessary depending on how many tiers of LEDs are used. As a result, several kinds of lenses need to be prepared. The present invention solves this problem by allowing the same kind of lens to be placed one on the other in several tiers according to the number of tiers of LEDs.

However, using a lens or lenses is itself a cost factor. Firstly, a process is required to make a lens or lenses. Secondly, because LEDs need to be arranged at the focal point of the lens, increasing the number of LEDs per tier necessitates that the diameter of the lens be increased. This means that for each distinctive quantity of LEDs, a different size of lens is necessary.

The present invention solves this problem by employing newly developed LEDs with an extremely wide horizontal divergence angle so that it is possible to make a lighting fixture for navigational aid without using a lens or lenses.

So as to achieve the first object of the present invention, the present invention arranges several elliptically light distributing LEDs radially (i.e., in a spoke-like manner) around a horizontal circumference in such a way that the wider divergence angle of each LED is horizontally oriented; and around the radially arranged elliptically light distributing LEDs, a lens that converges the light from the LEDs in the horizontal circumferential direction is provided.

By way the arrangement of the LEDs and lens as described above, it is possible to make the horizontal light distribution of the LEDs nearly concentric and uniform while using a small number of LEDs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross sectional view of an example of a lens unit comprising several tiers of unit-type tubular lenses according to the present invention, wherein in the center of each unit-type lens, elliptically light distributing LEDs are radially arranged around the horizontal circumference; and in this view, each one of the unit-type lenses is separated from other unit-type lens;

FIG. 2 is a cross sectional view of the lighting fixture according to the present invention in which four tiers of unit-type tubular lenses are installed on the base of the lighting fixture;

FIG. 3 is a cross sectional view taken along the line 3-3 in FIG. 2;

FIG. 4(a) illustrates the light distribution characteristics of conventional LEDs having a divergence angle of 30° for both the horizontal and perpendicular directions and being radially arranged around the horizontal circumference in the unit-type lens used in the present invention;

FIG. 4(b) illustrates the light distribution characteristics of elliptically light distributing LEDs having a horizontal divergence

angle of 70° and a perpendicular divergence angle of 30° according to the present invention;

FIG. 4(c) illustrates the light distribution characteristics of the same LEDs as in FIG. 4(b) with an exception that in FIG. 4(c) the inner surface of the lens is equipped with a diffusion part that diffuses light only in the horizontal direction;

FIGs. 5(a) and 5(b) show the function of the diffuser;

FIGs. 6(a) and 6(b) are schematic illustrations for contrasting two types of elliptic light distribution patterns produced by different elliptically light distributing LEDs, in which FIG.6(a) is an example of the present invention, and FIG. 6(b) is that of a conventional, commercially available LED.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The principle of the present invention will be explained first with reference to FIGs. 4(a) through 4(c).

FIG. 4(a) shows the light distribution characteristics of conventional LEDs having a divergence angle of 30° in both the horizontal and perpendicular directions. FIG. 4(b) shows light distribution characteristics of elliptically light distributing LEDs having a horizontal divergence angle of 70° and a perpendicular divergence angle of 30°, so that the LEDs are arranged so that the wider divergence angle of each LED is horizontally oriented. Comparing these two, it can be recognized that the radiation range is larger in the case of FIG. 4(b) than in the case of FIG. 4(a) even though the same number (six) of LEDs are used.

When several LEDs are arranged radially around a horizontal circumference or arranged circularly on a horizontal plane, and a lens 2 converging the light from the LEDs in the horizontal circumferential direction is provided around the LEDs, a higher horizontal light distribution performance is obtained as seen from FIF. 4(b) when

elliptically light distributing LEDs 1 are arranged so that the wider divergence angle of each LED 1 is horizontally oriented compared with when conventional LEDs having the same divergence angle, 30°, for both the horizontal and perpendicular directions, are used.

In other words, by using elliptically light distributing LEDs, it is possible to reduce the number of LEDs that are arranged horizontally. It is also possible to make the lighting fixture lighter and smaller.

As seen from FIG. 4(c), it is preferable to provide the inner surface of the lens 2 with a diffusion part D that diffuses light only in the horizontal direction. With the inner surface of the lens 2 that has the diffusion part D, even if the light distribution characteristics of the LEDs 1 are such that some areas remain unlit, as indicated by the white areas in FIG. 4(b), the light that passes through the diffusion part D is diffused, and as a result an ideal light-distribution condition as shown in FIG. 4(c) in which solid white areas are much smaller is obtained. In this way, it is possible to horizontally distribute light more uniformly.

From the opposite viewpoint, the diffusion part D on the inner surface of the lens 2 can accomplish horizontally uniform light distribution with a smaller number of elliptically light distributing LEDs 1. Even in a situation in which white areas appear because the number of elliptically light distributing LEDs 1 arranged inside the lens 2 is small as shown in FIG. 4(b), it is still possible to horizontally distribute light uniformly as shown in FIG. 4(c). As a result, the ultimate goal of the present invention is accomplished which is to make the number of LEDs 1 as small as possible.

The diffusion part D is preferably made of a film F (see FIG. 5(a)). It is possible to make the lens 2 of synthetic resin and to integrally mould the diffusion part D onto its inner surface; however, it is easier and more cost effective to use a film F as the diffusion part D and to paste it on the inner surface of the lens 2.

It is also preferable to form the lens 2 with several unit-type lenses 2a (see FIGs. 1 and 2). In the center of each of these lenses 2a, several elliptically light distributing LEDs 1 are installed in a horizontal circumference direction.

With this configuration, it is possible to arrange the several LEDs 1 easily and accurately on a horizontal circumference inside each lens, and it is also possible to easily make a lens unit in which the LEDs and the lenses are integrated.

Because the lenses 2a are of a unit type, they can be stacked or placed one on the other easily. An LED lighting fixture made of two or more tiers of unit-type lenses 2a can be easily assembled by simply stacking two or more of these unit-type lenses 2a.

By increasing or decreasing the number of unit-type lenses 2a, the number of tiers can be easily changed. Moreover, even if the number of tiers is changed, there is no need to prepare a special lens to accommodate the different height of the lighting fixture. Instead, only the number of identical unit-type lenses needs to be changed.

A screw 7 is preferably used so that it runs through the bosses (hubs) 2b of the stacked unit-type lenses 2a so as to fasten the unit-type lenses 2a.

With this arrangement, several unit-type lenses 2a can be stacked quite easily.

On the other hand, by using elliptically light distributing LEDs that have a horizontal divergence angle of 120° - 150°, which is wider than that of a conventional LED, and a perpendicular divergence angle that is narrower than that of a conventional LED, it is possible to make an effective navigational aid without using lenses at all.

By using such LEDs with an extremely wide horizontal divergence angle and a much narrower perpendicular divergence angle than those of conventional LEDs, lenses and the process of forming lenses become unnecessary. This lowers costs and enables a wide

variety of arrangements of the elliptically light distributing LEDs because there is no need to take into consideration the positions of the focal points of the lenses. Furthermore, the number of LEDs per tier can be increased without being restricted by the lens diameter.

Preferred embodiments and more detailed description of the present invention will now be described with reference to the accompanying drawings.

In the present invention, instead of conventional LEDs having a divergence angle of 30° for both the horizontal direction and perpendicular direction (indicated by 1′ in FIG. 4(a)), elliptically light distributing LEDs (indicated by the reference numeral 1 in FIG. 4(b)) that have an elliptic light distribution, at least in the horizontal direction, with a horizontal divergence angle of 70° and a perpendicular divergence angle of 30° are used. Several LEDs 1 are arranged radially around the horizontal circumference or arranged circularly on a horizontal plane so that the wider divergence angle is oriented horizontally, in this embodiment, so that the horizontal divergence angle is 70°. FIG. 4(a) shows an example that uses LEDs 1′ having the same divergence angle in the horizontal and perpendicular directions, FIGs. 4(b) and 4(c) show examples that use the elliptically light distributing LEDs 1 as employed in the present invention.

The difference in the light-distribution characteristics of these examples will be described.

In FIGs. 4(a) through 4(c), horizontal light distribution characteristics are shown above the perpendicular light distribution characteristics.

When FIGs. 4(a) and 4(b) are compared, it can be seen that while the same number of LEDs are arranged in the circumferential direction in each case, the illumination range is larger in the case of FIG. 4(b) than in the case of FIG. 4(a). This means that the elliptically light distributing LEDs 1 (according to the present

invention) have a substantially improved light distribution performance than conventional LEDs 1' having the same divergence angle in the horizontal and perpendicular directions. The principle of this concept is as explained before. In other words, by using elliptically light distributing LEDs, the number of LEDs arranged horizontally can be reduced. As a result, it is also possible to make the lighting fixture lighter and smaller.

As seen from FIG. 4(c), it is preferable to provide the inner surface of the tubular lens 2 with a diffusion part D that diffuses light only in the horizontal direction. With the inner surface of the tubular lens 2 that has the diffusion part D, even if the light distribution characteristics of the LEDs 1 are such that some areas remain unlit, as indicated by the white areas in FIG. 4(b), the light that passes through the diffusion part D is diffused, an ideal light-distribution condition as shown in FIG. 4(c) in which white areas are much smaller is provided. In this way, it is possible to horizontally distribute light more uniformly.

In other words, with the diffusion part D provided on the inner surface of the lens 2, it is possible to achieve horizontally uniform light distribution with a small number of elliptically light distributing LEDs 1.

The diffusion part D functions as a diffuser. The diffusion angle of the transmitted light, or more specifically, the X-axis (horizontal) diffusion angle and the Y-axis (perpendicular) diffusion angle shown in FIG. 5(b), can be controlled by adjusting the average height and average pitch of the ridges of the finely waved surface **d** shown in FIG. 5(a).

According to the present invention, the diffusion part D can only diffuse light in the X-axis (horizontal) direction; as a result, the diffusion part D or the diffuser achieves uniform light distribution in the horizontal direction.

The diffusion part D is preferably a film F. Although it is possible to form the tubular lens 2 with a synthetic resin and to integrally mould the diffusion part D on its inner surface, it is easier and more cost effective to make the diffusion part D as a film F and paste it on the inner surface of the tubular lens 2.

In order to arrange the elliptically light distributing LEDs 1 radially around the horizontal circumference, the tubular lens 2 to be located outside the LEDs is comprised of several unit-type lenses 2a; and inside and at the center of each of these lenses 2a, a plurality of elliptically light distributing LEDs 1 are installed radially around the horizontal circumference or installed circularly on a horizontal plane (see FIG. 3). These elliptically light distributing LEDs 1 are installed directly at the center of each of the unit-type lenses 2a. Instead, they can be mounted radially on a single circuit board 3, and this circuit board 3 in turn is secured to the boss 2b which is at the center of each unit-type lens 2a via screws 4.

According to this configuration, the LEDs 1 are arranged around the horizontal circumference inside the tubular lens 2 easily, accurately, uniformly and radially. Moreover, a lens unit in which the LEDs 1 and the lens 2 are integrated as shown in FIG. 1 can be made easily.

Because the lenses 2a are of a unit type, they can be stacked easily. An LED lighting fixture made of two or more tiers of unit-type LEDs can be easily obtained by simply stacking two or more of these unit-type lenses 2a. FIG. 2 shows an example of a lighting fixture in which four tiers of unit-type lenses 2a are stacked.

By increasing or decreasing the number of unit-type lenses 2a to be stacked, the number of tiers can be easily changed. Moreover, though the number of tiers is changed, there is no need to prepare a special lens to accommodate a different height of lighting fixture. Instead, only the number of identical unit-type lenses needs to be changed.

So as to prevent the unit-type lenses 2a from moving unnecessarily when they are placed one on the other, each of the unit-type lens 2a in this embodiment is provided with a protrusion (not shown) and an indentation (not shown) at the outer edge of either the upper end face or lower end face. Thus, when the lenses 2a are stacked, the protrusion of one lens engages with the indentation of another.

As shown in FIGs. 1 and 2, the unit-type lenses 2a are mounted on the outer casing 6a of a flasher case 6 mounted inside the base 5 of the lighting fixture, so that the unit-type lens 2a at the bottom does not move unnecessarily with respect to the outer casing 6a of the flasher case 6.

A screw 7 is used so that it runs through the bosses (hubs) 2b of the stacked unit-type lenses 2a so as to fasten the unit-type lenses 2a.

With this arrangement, in which the screw 7 is provided so as to run through and screws into a portion of the lighting fixture (the center of the flasher case 6 in this example), several unit-type lenses 2a are stacked quite easily and securely.

The circuit boards 3 in the centers of the stacked unit-type lenses 2a are all connected electrically with each other and to the flasher unit 8 inside the flasher case 6 as shown in FIG. 2. The several elliptically light distributing LEDs 1 mounted on the circuit boards 3 are also connected electrically and emit light in the direction of the perimeter.

In FIG. 2, the reference numeral 9 is a cover placed outside the stacked unit-type lenses 2a. The bottom of the cover 9 is fastened to the base 5 circumferentially.

The reference numeral 10 is a plug for holding a lead wire **c** in place at the point where it enters the base 5. The lead wire **c** is connected to the flasher unit 8. The reference numeral 11 is a photo sensor, 12 is a ring plate and 13 is an O-ring.

The above embodiment is an example of the present invention that uses a lens. The present invention can be applied to a navigational aid that uses no lens. In the navigational aid that uses no lens, elliptically light distributing LEDs having a horizontal divergence angle of 120° - 150°, which is wider than that of a conventional LED, and a perpendicular divergence angle that is narrower than that of a conventional LED, are used.

FIG. 6(a) shows the elliptic light distribution of an LED having a horizontal divergence angle of 120° - 150° and a perpendicular divergence angle of 10°.

FIG. 6(b), on the other hand, shows the elliptic light distribution of a conventional, commercially available, elliptically light distributing LED. The horizontal divergence angle and perpendicular divergence angle of this LED are 70° and 30°, respectively.

By using such LEDs that have an extremely wide horizontal divergence angle and a much narrower perpendicular divergence angle than those of conventional LEDs, lenses and the process for forming lenses becomes unnecessary. This lowers the costs and enables freer arrangement of the elliptically light distributing LEDs because there is no need to take into consideration the positions of the focal points of the lenses. Furthermore, the number of LEDs per tier can be increased without being restricted by the lens diameter.

To change the light-distribution characteristics of the elliptically light distributing LEDs 1, the shape of the resin lens that surrounds the LEDs 1 can be changed. For example, when widening the horizontal divergence angle from 70°, as shown in FIGs. 4(b) and 6(b), to 120° - 150°, the lens that surrounds the LEDs 1 is made flatter than in the case in which the divergence angle is 70°.

As seen from the above, according to the present invention, the horizontal light distribution characteristics can be nearly concentric with only a few LEDs. As a result, it is possible to

uniformly distribute light horizontally, and it is also possible to make the lighting fixture lighter and smaller.

Furthermore, according to the present invention, an ideal light-distribution condition can be obtained, and a horizontal light distribution can be more uniform.

In addition, a diffusion part can be easily formed on the inner surface of the lens by simply pasting a film on the inner surface of the lens, thereby providing a cost effective solution for such applications.

Also, in the present invention, several LEDs are arranged around the horizontal circumference inside the lens easily and accurately; and it is possible to easily make a lens unit in which the LEDs and the lenses are integrated.

In addition, according to the present invention, an LED lighting fixture including two or more tiers of unit-type lenses can be easily assembled by simply stacking two or more of these unit-type lenses. The number of tiers can be easily changed by increasing or decreasing the number of unit-type lenses 2a to be stacked. Moreover, even if the number of tiers is changed, there is no need to prepare a special lens to accommodate the different height of the lighting fixture. Only the number of identical unit-type lenses needs to be changed.

Also, in the present invention, several unit-type lenses are easily stacked in two or more tiers.

Furthermore, in the present invention, lenses and the process for forming lenses are unnecessary. This results in lower costs and enables freer arrangement of the elliptically light distributing LEDs because there is no need to take into consideration the positions of the focal points of the lenses. In addition, the number of LEDs per tier can be increased without being restricted by the lens diameter.

What is Claimed is:

1. An LED lighting fixture wherein a plurality of elliptically light distributing LEDs are arranged radially on a horizontal circumference so that a wider divergence angle of each LED is horizontally oriented.

2. The LED lighting fixture according to claim 1, further comprising a lens provided with a diffusion part that diffuses light only in a horizontal direction.

3. The LED lighting fixture according to claim 2, wherein the diffusion part is a film

4. An LED lighting fixture wherein a lens is comprised of a unit-type lens, and a plurality of elliptically light distributing LEDs are provided in a center of said unit-type lens and arranged radially on a horizontal circumference.

5. The LED lighting fixture according to claim 4, wherein said lens is comprised of a plurality of unit-type lenses that are stacked.

6. The LED lighting fixture according to claim 5, wherein the stacked unit-type lenses are fastened by a screw that runs through bosses of said unit-type lenses.

7. An LED lighting fixture comprising LEDs having a horizontal divergence angle of 120° - 150°, which is wider than that of a conventional LED, and a perpendicular divergence angle that is narrower than that of a conventional LED.

ABSTRACT OF THE DISCLOSURE

In the centers of each of unit-type lenses that constitute a lens, a plurality of elliptically light distributing LEDs being arranged circularly in a horizontal direction in such a way that a wider divergence angle of each LED is set to be oriented horizontally. The unit-type lenses are stacked and fastened by a screw that runs through the bosses of the unit-type lenses.

FIG. 1

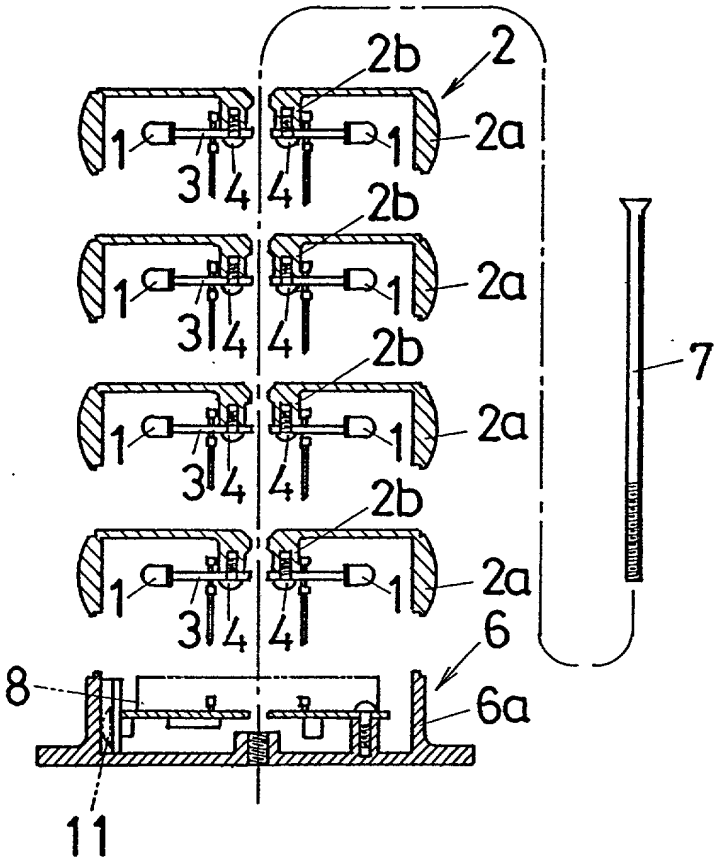


FIG. 2

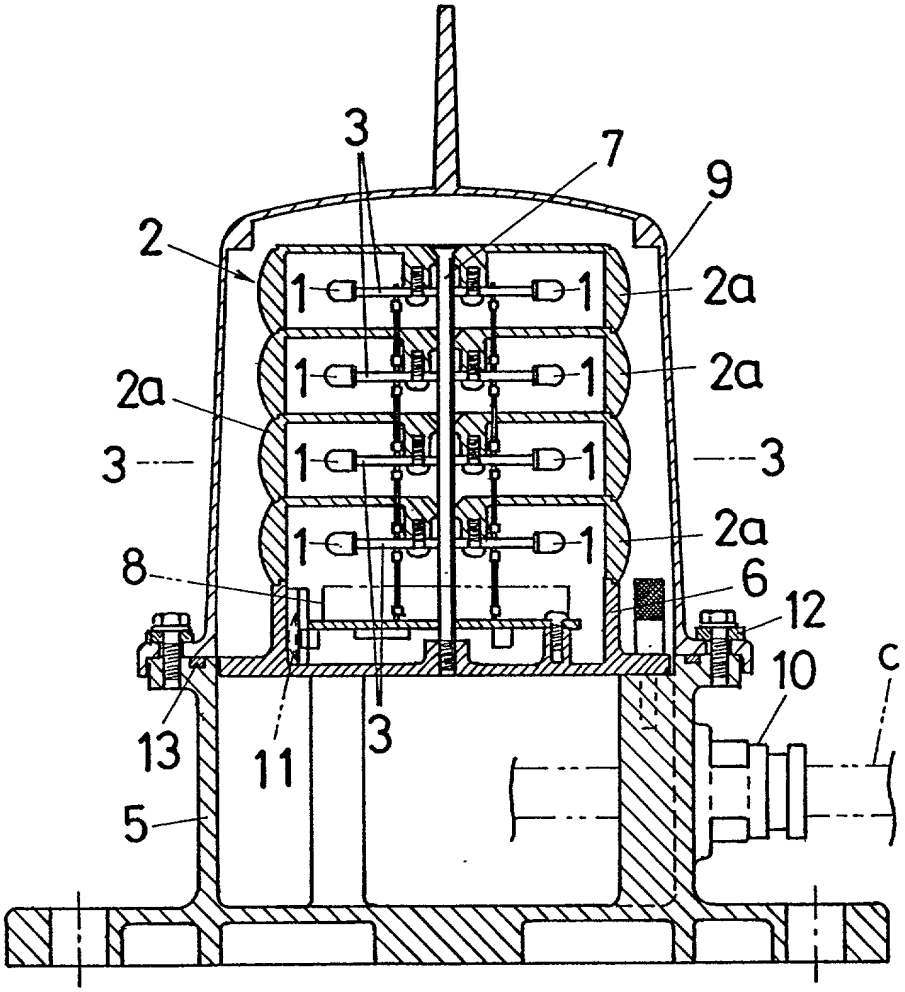


FIG. 3

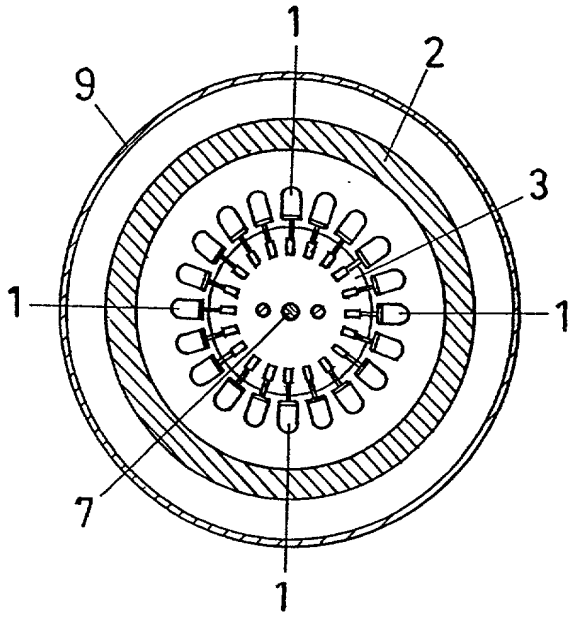


FIG. 4(a)

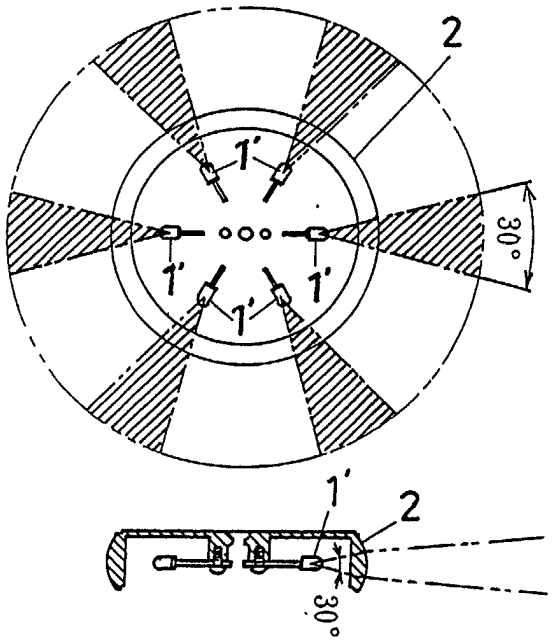


FIG. 4(b)

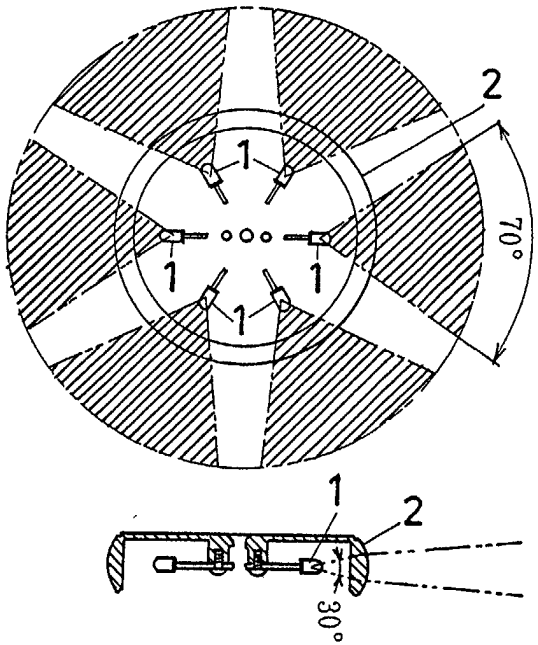


FIG. 4(c)

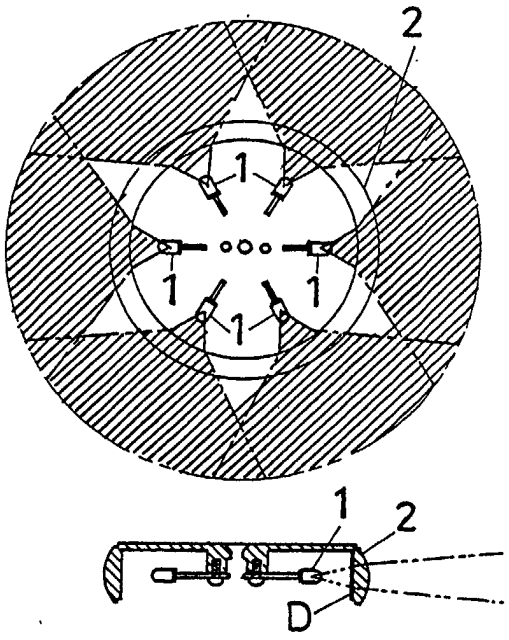


FIG. 5(a)

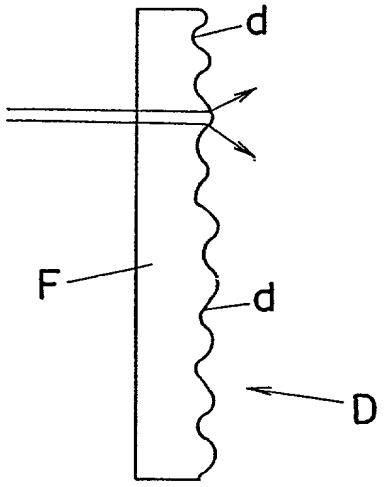


FIG. 5(b)

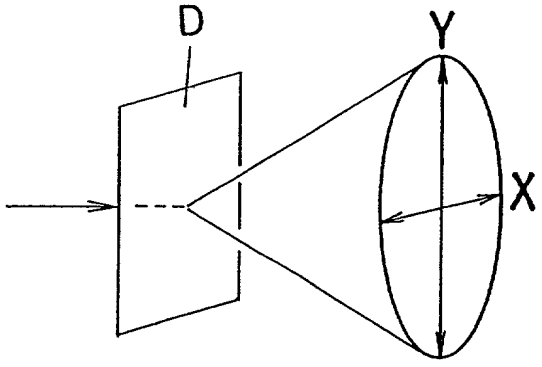


FIG. 6(a)

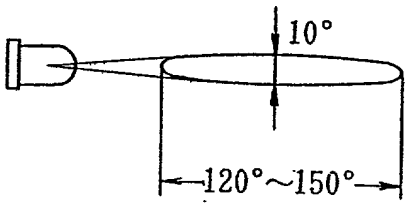
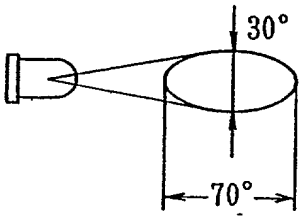


FIG. 6(b)
PRIOR ART



DECLARATION AND POWER OF ATTORNEY

PATENT (U.S.A.)
KODA & ANDROLIA
ATTORNEY'S DOCKET NO.
80A 3002

As a below named inventor, I declare that :

My residence, post office address and citizenship are stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

AN LED LIGHTING FIXTURE the specification of which is

attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or Inventor's certificate, or § 365(a) of any PCT International application which designated at least one country other than the United States, listed below and have also identified below, by checking the appropriate line, any foreign application for patent or Inventor's certificate, or PCT International application having a filing date before that of the application on which priority is claimed.

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING Month	Day	Year	PRIORITY CLAIMED
Japan	11-315519	11	05	1999	YES X NO ___
					YES ___ NO ___
					YES ___ NO ___
					YES ___ NO ___

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below.

APPLICATION NUMBER	FILING DATE

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

APPLICATION NUMBER	FILING DATE	STATUS – PATENTED, PENDING, ABANDONED

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected herewith.
WILLIAM L. ANDROLIA, REG. NO. 27,177; H. HENRY KODA, Reg. No. 27,729; ALEX CHARTOVE, Reg. No. 31,942.

SEND ALL CORRESPONDENCE TO:	DIRECT TELEPHONE CALLS TO:
KODA & ANDROLIA 10100 SANTA MONICA BLVD., SUITE 2340 LOS ANGELES, CALIFORNIA 90067	**KODA & ANDROLIA** (310) 277-1391

		FIRST NAME	LAST NAME	MIDDLE NAME	Residence CITY	STATE or COUNTRY
201	Name of Inventor	MITSURU	TAKEYASU		IKEDA	JAPAN
	Post Office Address	176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan				CITIZENSHIP Japan
202	Name of Inventor	TADAHIRO	ARIMURA		IKEDA	JAPAN
	Post Office Address	176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan				CITIZENSHIP Japan
203	Name of Inventor	YOSHIHISA	TABATA		IKEDA	JAPAN
	Post Office Address	176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan				CITIZENSHIP Japan
204	Name of Inventor	DAISUKE	KAIBARA		IKEDA	JAPAN
	Post Office Address	176-1, Toyoshimaminami 2-chome, Ikeda-shi, Osaka, Japan				CITIZENSHIP Japan

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements and the like may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202
Mitsuru Takeyasu	Tadahiro Arimura
DATE 17 July 2000	DATE 17 July 2000
SIGNATURE OF INVENTOR 203	SIGNATURE OF INVENTOR 204
[signature]	Daisuke Kaibara
DATE 17 July 2000	DATE 17 July 2000

☐ Additional inventors are named on separate Declarations attached hereto.

FORM DPA PAT (REV 07/96)

80A 3002

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Art Unit: --
MITSURU TAKEYASU et al.	Examiner: --
Serial No: --	
Filed: --	
For: AN LED LIGHTING FIXTURE	

CHANGE OF CORRESPONDENCE ADDRESS

Assistant Commissioner for Patents
Washington, DC 20231

Dear Sir:

Effective September 23, 2000, our office is located at the following address:

KODA AND ANDROLIA
2029 Century Park East, Suite 3850
Los Angeles, CA 90067-3024

Our telephone and fax numbers remain (310) 277-1391 and (310) 277-4118, respectively. It is therefore respectfully requested that the Patent Office change its records accordingly in connection with the above-identified application.

Respectfully submitted,

KODA AND ANDROLIA

By: _____
H. Henry Koda
Reg. No. 27,729

2029 Century Park East
Suite 3850
Los Angeles, CA 90067
(310) 277-1391
(310) 277-4118 (fax)